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NOTICES OF The Aëronautical Society of Great Britain.

At a meeting of the Council of the Aëronautical Society of Great Britain held at the Society of Arts, John Street, Adelphi, on Wednesday, July 12th, 1905, the following gentlemen were elected members of the Society:—

Mr. PHILIP W. L. BROOKE SMITH, R.E.
Mr. THOMAS DIXON COOK.
Mr. SAMUEL DALZIEL.
Mr. RAYMOND VERNON DOHERTY HOLWELL, R.E.
Mr. JOSÉ WEISS.

GENERAL MEETING.

The opening meeting of the Forty-first Session of the Aëronautical Society of Great Britain will be held at the Society of Arts, John Street, Adelphi, in December next. Amongst the papers read will be:—

"The Acoustical Experiments carried out in Balloons by the late Rev. J. M. Bacon," by Miss Gertrude Bacon.

Full particulars of the Meeting will be duly announced.

THE LIBRARY.

The following publications have been presented to the Library:—

By W. DE FONVIELLE: "Dupuy de Lôme" (Les Contemporains).—W. de Fonvielle.

By D. RIABOUCHINSKY: "Institut Aérodynamique de Koutchino."

By S. P. LANGLEY: "Experiments with the Langley Aërodrome."

FLYING MODEL COMPETITION.

The Flying Model Competition for the prize of ten pounds offered by Major B. Baden-Powell will be held at the summer meeting of the Aëronautical Society of Great Britain at Sunningdale, Ascot, in July, 1906. The following are the rules drawn up by the Council of the Aëronautical Society of Great Britain:—

1. The apparatus may be of any form, but shall not weigh, all complete, more than one pound.

2. No gas or hot air for buoyancy shall be used.

3. Any propelling force such as compressed air, petrol, spirits, etc., may be employed (although it is probable that india-rubber springs will alone be found practicable in so small a machine), but no springs, explosives, or other agencies apart from those carried by the machine and included in its weight shall be used to give an initial impulse.

4. The apparatus shall be started from the ground or from a table or releasing gear not more than six feet above the ground.

5. The apparatus shall fly through the air for a distance of at least 100 feet, so that the distance from the ground from place of starting to place of falling shall be when measured in a straight line, not less than 100 feet. It must accomplish this distance twice over (with a short interval between) in opposite directions.

6. The prize will be given to the competitor whose machine covers the greatest distance.

7. The prize will not be awarded unless there are three or more genuine competitors.

8. Each competitor shall be held responsible for any damage or accident that may occur to or by means of his apparatus.

9. The competition shall be open to all of any nationality, who shall be approved by the Council of the Aëronautical Society of Great Britain.

10. Members of the Aëronautical Society of Great Britain shall have to pay no entrance fee, but to non-members there shall be an entrance fee of five shillings for those who are entered before the end of 1905, and half a guinea for those who are entered between January 1 and April 30, 1906, the latter being the last day for receiving entries.

11. The award of the prize shall be decided by a jury of at least three members, to be appointed by the Council of the Aëronautical Society of Great Britain, who shall decide all points of doubt and use their discretion as to the disqualification of any apparatus which they may consider not to comply with the original purpose of the competition, or one which they consider in any way dangerous.

12. The decisions of the jury shall be accepted as final.

In issuing these general Rules the Council reserve to themselves the right of making any modification or additional regulations which may tend to facilitate the carrying out of the competition.

The following have already kindly consented to act on the Jury:—

Major B. Baden-Powell (President Aëronautical Society of Great Britain), Mr. E. P. Frost, J.P., D.L., Lt.-Colonel Fullerton, Sir Hiram S. Maxim, Dr. Hugh Robert Mill, D.Sc., LL.D., Colonel F. C. Trollope (late Grenadier Guards), and Mr. Eric Stuart Bruce, M.A. (Hon. Secretary Aëronautical Society of Great Britain).

All communications respecting this competition should be addressed to the Honorary Secretary, Aëronautical Society of Great Britain, 53, Victoria Street, Westminster, London, S.W.

ERIC STUART BRUCE,
Honorary Secretary.

GENERAL MEETING.

The concluding meeting of the fortieth session of the Aëronautical Society of Great Britain was held at the Society of Arts, John Street, Adelphi, on Wednesday, July 12, 1905. The President, Major B. F. S. Baden-Powell, was in the chair.

The Honorary Secretary read the minutes of the last meeting.

The PRESIDENT: The first paper of the evening is on "Aërial Flight," by Mr. F. H. Wenham, whose name is very well known in this Society. He is the oldest member of it, and, unfortunately, Mr. Wenham is not able to be here, so that paper will be read by the Hon. Secretary.

Some Remarks on Aërial Flight.

By F. H. WENHAM,
Honorary Member of the Aëronautical Society of Great Britain.

During the past year considerable advance has been made on the question of Aëronautics relating to flying arrangements heavier than air (exclusive of balloons). I have always maintained that the power required for bird life has been much over-estimated. Take, for example, the flight of the pelican, which I have often witnessed. A dead bird weighed 21 lbs., with an extent of wings of 10 feet from end to end, speed 70 strokes per minute, each stroke averaging about one foot. It is evident that during a period of gliding flight with motionless wings these sustain the whole weight of the bird. The exertion or force will be during the oscilating or downstroke of the wing against this pressure. The estimate stands thus:—Pressure 21 lbs. at 70 ft. per minute = 1,470 foot lbs. $\frac{1470}{33000}$ or near $\frac{1}{22}$ h.p. According to this estimate a man with suitable adaption would have ample power for individual flight. I have some doubt whether the action of the flight of birds is yet distinctly understood. In many flyers the downstroke is much more rapid than the upstroke; it is during this slow return that the chief weight-carrying effect is obtained. The wing is slightly swivelled to the raising angle support; it is the sudden impact on the air by the quick downstroke that gives the abutment. Air being elastic, requires time for compression, and against sudden

impacts will yield to a less extent than with gradual pressure, as exemplified by the action of dynamite against solid rock or the muzzle of a gun closed with a thin wad or choked up with snow, the gas from the powder having no instantaneous vent will burst the barrel.

The difference in the up and downstrokes of a bird's wing during flight cannot be observed. I have before me a reciprocative arrangement making 175 strokes per minute. The quick downstroke is double the speed of the return, but to the eye they appear to be the same. Small birds of the finch tribe have an undulating flight; they take a few rapid wing-strokes by which they obtain an impact on the air sufficient to impel them several feet, and so progress by a series of kangaroo-like jumps by finding an abutment from quick strokes given at intervals.

In my essay, read before the Aëronautical Society at their first meeting in June, 1866, I pointed out reasons why man flight could not succeed with only single plane-surface, and, therefore, duplicated them as separate aëroplanes—a name given by myself—though they are properly curved surfaces. This system of combined planes has been found so essential that they have been adapted by subsequent experimenters. My greatest difficulty arose from defective stability; I foresaw that if I cast myself off from an altitude a disaster would result. This defect of equilibrium and stability has since been overcome, as shown in the historical work on aërial flight by Mr. Octave Shanute.

As to the means of propulsion I did not see my way to the adaption of a screw propeller for man's strength, but proposed a pair of extended reciprocating side blades or paddles worked by the feet. Individual gliding flights for short distances have been quite successful, but I am not aware that any attempts to prolong or continue the flight by mechanical arrangements have yet been tried.

Regarding the last sentence in this paper the Honorary Secretary reminded the members that Messrs. Wright, in America, had recently applied motive power to their machines, but had hitherto kept the results of their experiments secret.

The PRESIDENT: The remarks that have now been made are of considerable interest. The subject of the flight of birds is one which we are going into to-night, later on, and I hope we shall see some interesting experiments with models of birds.

The Vertical Screw Aërial Machine, with Special Notes on the Lifting Propellers.

By WILLIAM GEORGE WALKER, C.E.

This machine was taken in hand in 1899 with the assistance of Mr. P. Y. Alexander. A staff of competent draughtsmen were employed in getting out fully detailed working drawings of different powers. The propellers are 30 feet in diameter revolving in opposite directions mounted on separate shafts, one inside the other, by this means the necessary reactions for rotation is obtained. The steam engines are below; the engines in this particular design are of somewhat novel type; the bed plate cylinders are connected to one of the shafts, the outer one, and the crank shafts to the inner one, so that we have the engine bed cylinders, etc., revolving in one direction, and the crank shaft in the opposite direction.

The engine was composed of two cylinders opposite each other so as to effect a perfect balance. The cage containing the water tube boiler and place for the man is seen below.

A machine was designed to give a lift of about 1,200 to 1,300 lbs. capable of carrying one man.

The power of the engine being about 50 b.h.p., or a lifting thrust of about 24 lbs. per b.h.p., it was decided to use steam at a pressure of 150 lbs. on the square inch.

The machine was to be made of high grade class steel.

The problem was to design a machine capable of lifting itself and a man off the ground.

By numerous calculations and experiments I came to the conclusion that in the case of machines of this type a minimum of 50 h.p. would be necessary to lift a man off the ground.

After a number of repeated sets of drawings had been got out I came to the conclusion that a machine of this kind could be constructed to weigh about 1,100 lbs., or about 1,300 lbs. with man and fuel, the water and fuel to last ten minutes. We knew exactly what the propellers would do, so that it was only a question of weight of machine for necessary power. The motive power proposed was steam, but taking into account the many little complications

which were sure to crop up, and in consideration of the small margin of lifting power over calculated weight, it was decided not to make the machine, but the propellers were made and tested.

The 30-foot Diameter Propeller.

The 30-foot diameter air propeller was mounted on a horizontal shaft. The propeller was of the double kind built up of solid drawn steel tubes tied and strutted together. The propeller was designed to give a thrust or lifting power of 600 lbs., and having a factor of safety of 3½, it weighed 120 without the canvas, the idea of the double form or superimposed structure was for reasons of strength.

It is on the same principle as a lattice or "warren" girder supported at one end and loaded at the other, the members of one blade being in compression and the other in tension.

This propeller was tested, and it gave way with 600 lbs. on the extreme top or 1,200 in propeller, a deflection curve was taken which showed that even with 600 at the top it was well within the limits of elasticity.

Five different propellers were tried all of 30 feet diameter, but of differently arranged surfaces.

The propeller was mounted on a horizontal shaft 4 inches diameter, driven by a portable engine by means of a 6-inch belt. The propeller shaft was free to move in its bearings longitudinally, a powerful antifriction swivel was attached to the end of the shaft on the discharge side of the propeller, to which was attached a Salters balance capable of reading up to a pull of 1,000 lbs. and reading to a pound.

The result of one of the screws is shown in the table.

The thrust and horse-power are shown plotted in diagram Fig. 1.

The thrust per h.p. is shown plotted in Fig. 2.

The following laws were verified:—

1. The thrust varies as the square of the revolutions.
2. The h.p. varies as the cube of the revolutions.
3. The thrust per h.p. varies inversely as the revolutions.
4. The thrust was directly proportionate to the area at same revolutions.

On referring to the result of the experiment of the 30-foot propellers it will be seen that the thrust per h.p. varied from 52 to 18, and that it varies inversely.

I suggest a thrust of 25 lbs. per h.p. as being the most practical.

As regards the practicability of an aërial machine of this kind, its possibility of success is much more favourable now than it was six years ago on account of the development of the light petrol engines, which are now on the market and made to 100 b.h.p. These engines can now be made at

PROPELLER E.

FOUR WIDE BLADES. AREA 350 SQ. FT. ANGLE OF BLADES 21 DEG.

Revolutions of Propellers ..	20	25	30	35	40	45	50	55	60
Tip Speed in feet per minute	1880	2350	2820	3290	3760	4230	4700	5170	5640
Thrust in Pounds	32	45	62	84	109	143	188	245	288
Indicated Horse Power ..	1.1	2.1	3.4	5.1	7.2	9.2	12.8	16.6	20.8
Brake Horse Power	.4	1.1	2.1	3.4	4.9	6.8	8.9	11.6	14.6
Thrust per Brake Horse Power	150	52	38.7	31.7	26.6	24.4	21.4	20.9	18.0
,, ,, Indicated ,, ,,	52.4	29.6	24.9	21.6	18.6	17.1	15.0	14.6	12.6
Horse Power Friction of Unloaded Engine	.7	.9	1.1	1.3	1.5	1.8	2.1	2.3	2.6

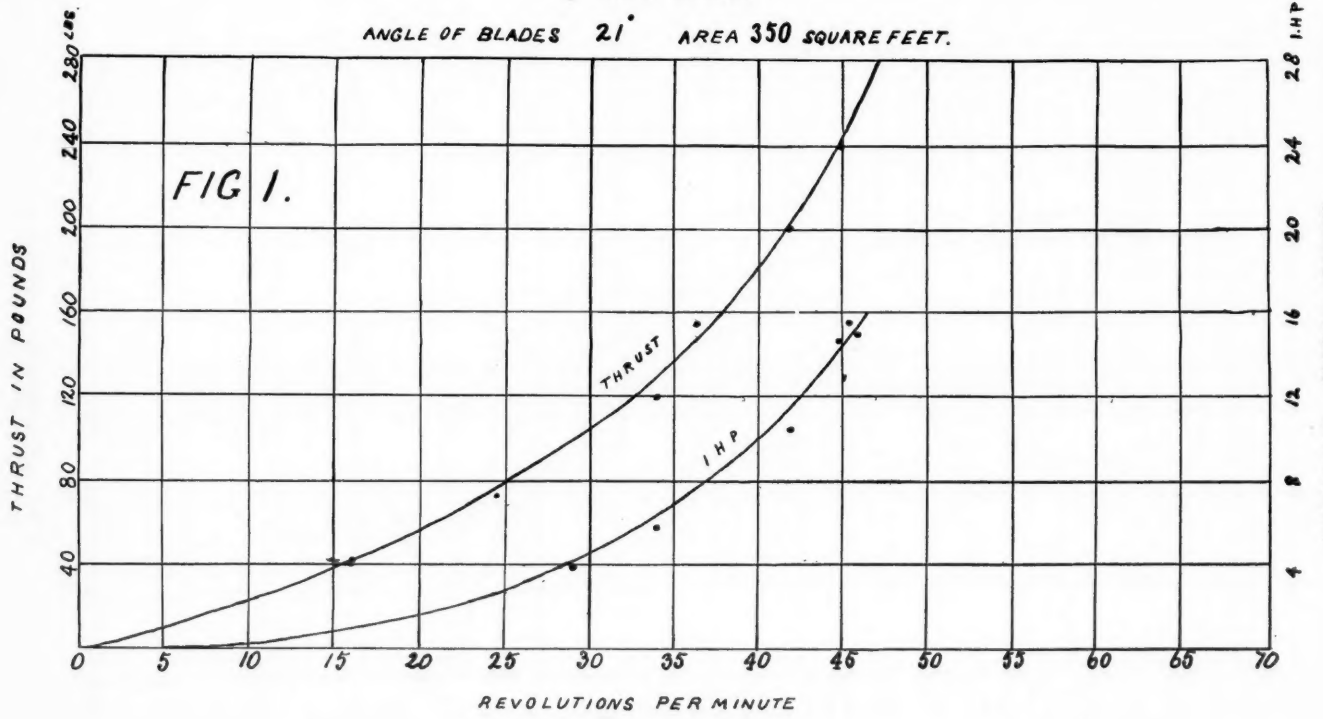
PROPELLER **E**.

DATE OF EXPERIMENT Oct 16th 1899

4 WIDE BLADES

ANGLE OF BLADES 21° AREA 350 SQUARE FEET.

FIG 1.



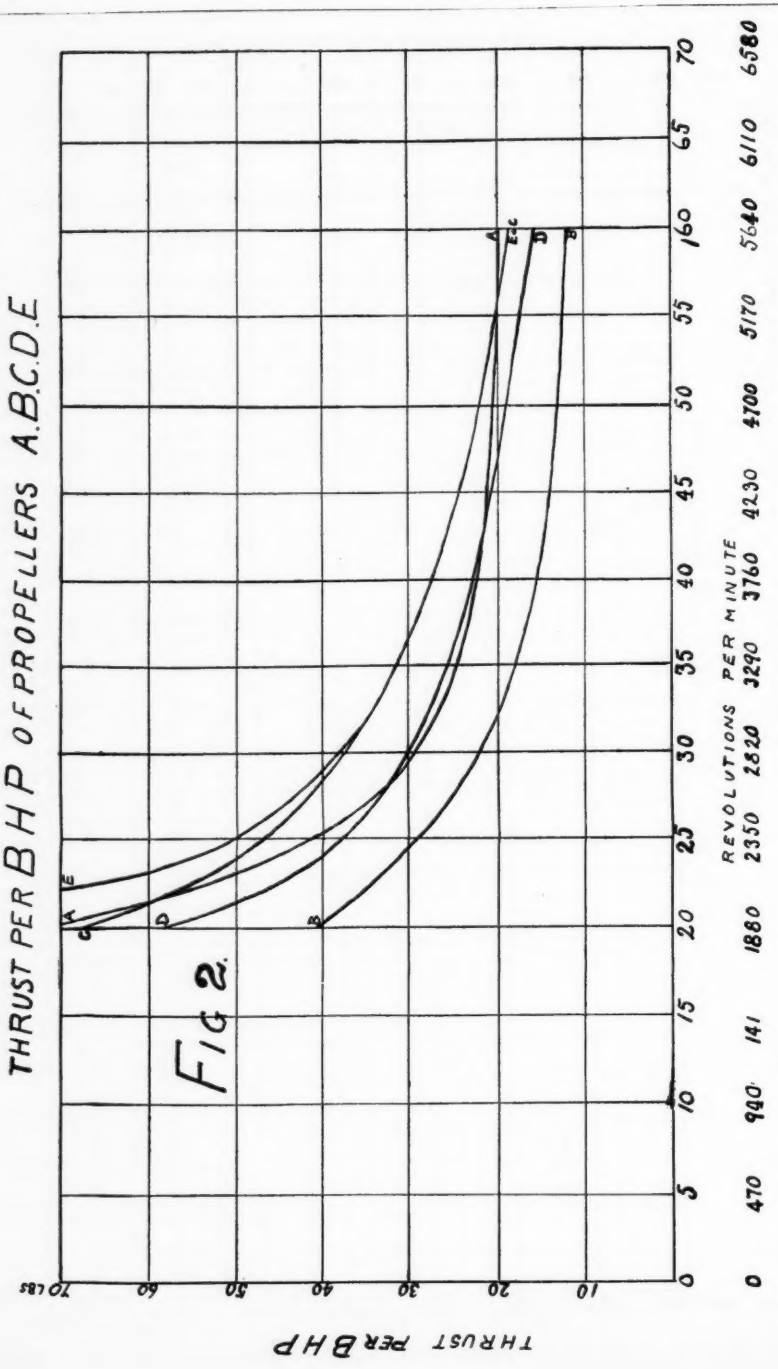

THRUST PER B H P OF PROPELLERS A.B.C.D.E
THRUST PER B H P
0 10 20 30 40 50 60 70 LBS
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
REVOLUTIONS PER MINUTE
0 470 940 141 1880 2350 2820 3290 3760 4230 4700 5170 5640 6110 6580
TIP SPEED
A
B
C
D
E

Fig 2.

a weight of say 15 lbs. per h.p., and my propeller will give 25, or if necessary, 30 lbs. per h.p., so that we have a margin of 10 or 15 lbs. per h.p., for the weight of the propeller, shifting cage, man, and fuel, which should prove ample.

To my mind a direct lifting machine of this kind is much easier of accomplishment than the aëroplane machine type, inasmuch as it can start from rest. And it would, of course, be an achievement if a machine could be constructed capable of lifting itself together with a man off the ground.

The point is this, I have proved by direct experiment that I can get a lift of 1,400 lbs. with propellers 30 feet in diameter and with 50 b.h.p.

The question is, can a machine be made capable of generating 50 h.p., and weighing with a man 1,400 lbs. My answer to that question is in the affirmative.

The design of propellers is most important; small alteration in the pitch, diameter, surface, etc., affects the efficiency to a considerable extent. Even the backs of the blades play an important part, which I can illustrate by this experimental apparatus in operation.

We have here a pair of three-bladed propellers 24 inches in diameter, one of them reversed to face the other, which are fixed about 2½ feet apart on the same spindle, so that both can run at the same speed, and each act to propel a current of air inwards against the other. Between them is a cardboard disc of the same diameter, loose to slide and turn freely upon the spindle. Obviously it assumes a position mid-way between them when they are in action, the pressure on each side of the disc being equal, because the blades of both propellers are flat and set at the same angle to the plane of rotation. On now adding rounded backs upon the blades of one of the propellers, giving a plano-convex section, its power is so much increased thereby that it blows the disc away from it along the spindle and forces it right up against the opposing unbacked propeller.

The PRESIDENT: This has been a most interesting contribution to the subject of aërial propellers. Unfortunately, we have had so very few experiments in this line, and of the experiments that have been made very little has been published. It is a very valuable thing for an experimenter to come forward and tell us some of the results of careful experiments. Some year or two ago I myself read a short paper on the subject of aërial screws, but the apparatus which I employed was a very crude, toy-like arrangement as compared to what Mr. Walker has been experimenting with, and the results that I had secured, as I said at the time, were of no great importance. I think this experiment that he made here of showing the extraordinary effect that the back of a propeller has, is most remarkable and most interesting, and I am very glad that he has been able to show us the whole thing complete. These are the sort of experiments that are much wanted. It seems to me probable that the aërial machine of the future will be driven by screw propellers, and though we may find that it is a bird-like apparatus, it seems to me more probable that it will be by screw propellers, and, therefore, experiment in that line is very much wanted. I rather think that Mr. Walker assisted Dr. Barton in making the propellers for his machine. He did not refer to them, but I hope he may be able to tell us some details of them.

DR. BARTON: Mr. Walker made four sets of propellers for my airship, but, unfortunately, we tried them on the ship whilst it was in the shed; we came to the conclusion that the weight was too much, and we were obliged last October to lighten the ship so as to do away with these huge propellers. We replaced them by four 7-foot propellers with a large back, very much in the same state as that one is which he has shown you. The angle of the propeller was 12½°, and instead of revolving at 140 revolutions per minute, the 7-foot propellers revolved just on 1,000 a minute. If one is to judge anything by the draught, I should say the smaller propeller was far more efficient. The wind speed off that propeller was calculated at 60 miles an hour; it had a tip speed of 240 miles an hour, and gave a blast of 60 miles. Personally, I do not think there is much to go by in the blast a propeller gives, and I do not see really that that last experiment proves much as regards the thrust, because if you take a Blackman fan, it gives an enormous blast, but little thrust. What we want is a propeller which gives little blast, but takes up the whole of it in thrust. The Blackman fan gives much blast, with comparatively little thrust. To-day, as, perhaps, you may have heard, we made an ascent from the Alexandra Palace with a large airship. There was a fairly stiff breeze blowing, it

was calculated at 20-25 miles an hour, and we were easily able to make slow progress against it. We went up 50-60 feet, and we wanted to go away—there were six of us on the airship—it was beautifully steady and very satisfactory in every way, but we were under an agreement with the Alexandra Palace not to go away to-day, and the public trial will take place on Saturday week, when we shall go away. I hope we shall be able to prove that it is able to steer in many directions. It was a satisfactory trial, and undoubtedly everyone saw that although it was blowing fairly well, we made steady progress against the wind. We were right dead in the face of the wind.

COLONEL FULLERTON: I should like to ask what the pitch of the propeller was, and what was the area of the surface in square feet.

MR. WALKER: I should like to refer to one point in connection with the smaller propellers spoken of by Dr. Barton, and I should like to know if he has made any experiments with them. So far as the propellers he mentioned are concerned, I did supply them to design, but, as a matter of fact, I did not make them. I know they were heavy—if I remember rightly they weighed about 80-90 lbs. each. I do not remember any experiments being made as regards the horse-power they absorbed or the thrust they gave. So far as the draught is concerned, it is a mistake to think that because a propeller gives a big draught the efficiency is going to be high. The efficiency of a propeller practically varies inversely as the cube of the draught. The great function of the designer is to keep down the draught as much as possible, and we do that in the designing of large propellers. We go in for a large surface, and by taking a large quantity of area we can set in motion the adverse current at a smaller velocity. If you take the Jet propeller, which has a velocity of 2,000 feet a second, the efficiency reaches ½ per cent. But where we reduce this adverse current the efficiency increases till it becomes a maximum. Between those two points of an infinitely large and infinitesimally small current of air, there is a point which should give the efficiency which we should require. I think a gentleman asked a question in connection with the angle of these propellers. We tried them at various angles. That propeller was tried at an angle of 21° and an area of 350 square feet.

COLONEL FULLERTON: Of the two blades?

MR. WALKER: Of the two blades, one behind the other. It is a peculiar fact that they do not reduce the thrust. When there were four blades we had it going at 60 revolutions a minute, and it gave a thrust of 200 lbs. We removed one blade, but it gave half the thrust at the same number of revolutions. We tried it with three blades and found that the juxtaposition of these blades did not seem to affect the draught at all.

The interval between the blades was three feet. The total width was six feet. Various experiments were carried out. The first blades we tried were 15 feet in length and six feet across. By cutting off half the canvas, and thus having a blade half the width, the efficiency remained just about the same. In fact, the results were practically the same within 2 per cent. or 3 per cent. This definitely shows that a narrow blade is more efficient than wider ones, which we know by many ordinary experiments. In another experiment we had a long blade measuring 15 feet, we cut away the canvas so that only the tips remained, and we found that it hardly reduced the thrust or the power, so the central part of the blade has no effect in connection with the propulsion.

THE PRESIDENT: I will now ask for a vote of thanks to Mr. Walker for his most interesting paper, and call upon Dr. Hutchinson to give his demonstration with his bird-like flying model.

DR. HUTCHINSON: I made the acquaintance of Mr. Frost some years ago, and his theory of flapping wings appeared to me to be a sound principle. He held certain theories on the action of a bird's wing, which theories I have endeavoured to express in the paper which appears in the current number of your Journal. His machine was never properly tested, because there were no means of supplying it with power. The principle appeared to me to be perfectly sound. Arguments against copying Nature do not appear to me to carry weight. For instance, Nature has never evolved a wheel, because Nature must have continuity of nutriment, and it is impossible to make a wheel with physiological continuity in the parts. In the propulsion of big ships we have not followed Nature, because it was insuperably difficult to make a ship copy the motions of an eel, so we have used screws, but in aërial flight it is not difficult to copy Nature if Mr. Frost's theory is true, namely, that the wing has to be

merely flapped. That being so, it was desirable that a proper test of Mr. Frost's views should be given. We first made just a crude apparatus to test the principle, and then went on to our No. 2 model, which has a 3-3¼ horse-power cycle engine. This, so far, has only been tried under bad conditions. It was not allowed to have any forward velocity, because it was tied by a rope, but the results indicate a most promising advance on the No. 1 model. The model was hung, and there was a spring balance, and the limit reading was about 160 lbs. This is only intended as a model, to demonstrate whether Mr. Frost's views (which were enunciated some 20 years ago) are worth pursuing in the light of modern aërial progress. The brothers Wright, in America, are said to have flown with a machine which weighs about 60 lbs. per horse-power, and our experiments with No. 1 and No. 2 models approximate to these results, and are in accord with the views of many authorities, namely, that to fly you want about 1 horse-power per 50 lbs.

The PRESIDENT: I understand Major Moore is here. We all read a paper he wrote—a very good paper—some years ago before this Society on a somewhat similar device of a wing-flapping machine worked by an electrical engine.

MAJOR MOORE: I should like to ask whether Dr. Hutchinson has read the report which our President has been good enough to mention. He will see these A.B.C. experiments have already been made, and it seems a pity to go over the same ground again; it is a waste of money and energy. We should make some progress. I read Dr. Hutchinson's report in the last journal; he seems to advocate wings because the air passes through the feathers. I should like to know what he thinks about flying foxes which have not feathers and yet fly. That, I think, rather shows that the air does not pass through the feathers at all. There are other matters, too. He speaks of the pectoral chord. A great deal depends on the pectoral muscles.

DR. HUTCHINSON: The pectoral chord is a mechanical device that prevents heavy alternation of load on the transmission.

MR. INWARDS: There is an important difference between the action of the model and the living bird, inasmuch as in watching the living bird one sees the ends of the feathers take a curve and slightly open. These feathers seem cropped at the end so that flight cannot take place. One would have looked to see the experiment made under conditions as like the living bird as possible.

MR. CODY: I should like to mention that there is no need, in my opinion, to imitate Nature. Steamships do not, and I do not see the advantage of imitating the bird's wing if you can get a flight on the square body instead of doing it in a way that is difficult to build strong and light. The bigger the spread of the artificial flight surface the better it will go. It is not a question of the wind, it is a question of handling it in a proper way. I mean to show this with a glider of 900 feet of lifting surface, and that is more than twice as big as any machine we have built. It only means the proper handling to make it go straight and correct.

MR. WALKER: In reference to the remarks of the last two gentlemen as to whether there is any connection between practical work and nature, I am not certain that there is no connection. If you take a transverse section through a bird's wing, it is hollow underneath and concave on the surface. If you take a section through those blades it is thicker in the centre, and it is thus similar to the section of the bird's wing.

MR. SENECAL: I should like to ask a question as to how Dr. Hutchinson locates the pressure, also his centre of gravity, also why he places the wings so much forward, and why they are so wide as that. The tail narrow and better made would be more efficient. The weight of the whole body seems to be too much backward and has no impulse for the machine to go forward. Also the beam is a drag on the machine. It is not a proper experiment. The beam is very heavy and clumsy, and spoils the experiment altogether.

COLONEL FULLERTON: I would like to ask how much the lift is. I think the paper says a lift of 2 feet.

DR. HUTCHINSON: The No. 2 model rises about 2 feet. We have 3-3¼ horse-power, and it rises about 2 feet. It is 230 lbs. in weight.

The PRESIDENT: I will now ask you to grant a vote of thanks to Dr. Hutchinson. As regards what Major Moore has said, I think it is a pity to throw cold water on any experiment in this subject (hear, hear). Although the ground may have been gone over on certain lines, a fresh experimenter taking up the subject is sure to go on

slightly different lines, and slightly different lines may affect the whole result. Major Moore's chief line of experimentation was with wings made on the principle of bats' wings, not with feathers. I think there is a great promise in the former, because it is an easier form to make artificially, and some of these flying foxes have a considerable power of flight. I will now ask you to return a vote of thanks to Dr. Hutchinson for so kindly demonstrating this model.

Dr. Hutchinson: Mr. Chairman, I am much obliged for the vote of thanks. A gentleman made a suggestion with regard to the primary feathers being stiff. Our No. 2 model has the feathers opening out like a bird in flight, and we think that wings are made as a means of getting a point d'appui against the air for the reason that they do open out. Resistance is a function of periphery, more so than of area. That bird is working under bad conditions because the primary feathers are dry and stiff. The wings of our No. 2 model open out, and all the primary feathers open separately, so that they act as a series of independent aëroplanes.

Mr. Keith: Speaking about the primary feathers, in examining wings years ago, I happened to be skinning a bird, and in moving the muscle which lies between the radius and the ulna, I found that if you pulled a certain muscle the wing curved over, and if you pulled the other muscle it rose. In the downstroke if it came down like a cup it would catch better, and in the upstroke if the heavy front feathers went a little up it would rise better.

Mr. Weiss: With regard to the bird's feathers, I succeeded last year in making a dead bird fly right across our lawn which is 40 yards without any impulse whatever. I did it several times. I was unable to keep it up because the wings got stiff. I have tried several other birds, but have not succeeded. Since then I have tried to imitate that same shape in paper and I got some considerable result because I have managed to obtain an angle of 21°; that is, a drop of only one-twelfth. What this gentleman said with regard to the area I believe to be a mistake. It is absolutely necessary that the weight should be in exact proportion to the area. This is absolutely true with birds. I have found it by testing some 40-50 birds. There is one factor, that is the fourth power of the surface divided by the third power of the weight, and that is an absolute factor in all birds. So much so that if any bird is brought to me I will undertake to tell the weight of that bird within 2 per cent. I have tested on my aëroplanes—some of you have heard of the results in Paris, where I did the best record of flight. I obtained an angle of 1/12, and I know unless the thing is weighted exactly according to that formula it does not fly. I have one model which weighs 9 lbs; if I weight it to 7 lbs. it does not fly, but if I weight it right it takes absolutely straight flight.

Balloon Varnishes and their Defects.

By WALTER F. REID, F.I.C., F.C.S.

From the very beginning of aëronautics difficulty was experienced in obtaining an envelope sufficiently impervious to gas to prevent excessive leakage, and yet not so heavy as to diminish unduly the ascensional power of the balloon. The first balloon, constructed by the brothers Montgolfier in 1783, was made of cotton fabric lined with paper and sewn on to a network of string. Faujas de Saint-Fond, who published a description of the experiment the same year, says that the gas escaped rapidly. Etienne Montgolfier corroborates this, attributing the escape chiefly to the needle-holes in the envelope. Had the balloon not been of large size, 35 feet high and containing 22,000 cubic feet of air, it would probably have descended before the lapse of the ten minutes that the experiment lasted. In this first experiment hot air with a large admixture of steam was the gas employed. Six years previously, however, Cavendish had discovered hydrogen, and it was natural that this light gas should be utilised in developing the new invention. Three months after the first experiment another balloon was made and inflated with hydrogen. This time the envelope was constructed of silk, coated with varnish. India-rubber, which had been discovered in Peru by La Condamine in 1736 and by Fresnau and Macquer in Cayenne in 1751, was an ingredient in this varnish. Even with these improvements, however, the new balloon cannot have been very satisfactory, for, although its capacity was only 944 cubic feet, it took four days to fill with gas, and the leakage of the latter was rapid. We

see, therefore, that from the very commencement of ballooning the necessity was recognised of employing some substance to fill up the pores of the envelope containing the gas, and, with very few exceptions, that necessity still exists. The great majority of balloons are now made of fine cotton fabric, considerations of price more than of efficiency preventing the general use of silk and of animal membrane. This cotton is dressed with varnishes of various kinds, those with linseed oil as the main constituent predominating. Varnishes may be divided into two classes—those in which the film solidifies or "dries" by absorption of oxygen from the air, and those in which the varnish "sets" by the evaporation of a volatile solvent in which the solid ingredients have been dissolved. To the first-class belong the drying oils, chiefly linseed oil, for, although there are a number of "drying" oils, but two or three of them are used commercially in the manufacture of varnishes. When exposed to the air, especially in warm weather, linseed oil absorbs oxygen and forms an elastic, translucent mass termed by Mulder, "linoxyn." This linoxyn has completely lost its oily nature, does not soil the fingers, and is, next to india-rubber, one of the most elastic substances known. It possesses but little tensile strength, however, and can be crumbled between the fingers. It forms the basis of all linseed oil paint films, and is largely used in the manufacture of linoleum. Linoxyn, however, is not, as Mulder supposed, the final product of the oxidation of linseed oil. When exposed to the air it is still further oxidised, and then forms a sticky, viscid mass, of the consistency of treacle and of an acid reaction. This latter property is of importance because it is due to it that fabrics impregnated with linseed oil so soon become rotten. In order to hasten the oxidation of linseed oil it is usually heated with a small quantity of a lead or manganese compound, and is then ready for use. No method of preparation can prevent the super-oxidation of linseed oil, but experience has indicated two ways of diminishing the evil effects so far as paints and varnishes are concerned. The first is to mix the oil with substances of a basic character or with which the acid product of oxidation can combine. In the case of paints, white lead or zinc oxide are chiefly used for this purpose. The other method consists in mixing with the oil a gum resin which renders the film harder and prevents liquefaction. Such a mixture of linseed oil and kauri gum forms an elastic, tough mass, which is much more durable than the linoxyn alone, and also possesses greater tensile strength. During oxidation the linseed oil absorbs about 12 per cent. of its weight of oxygen, and when the area exposed is very large in proportion to the weight of the oil the temperature may rise until the mass catches fire. At a high temperature the super-oxidation of the oil takes place more rapidly than in the winter, and I have seen fabrics that had only been impregnated with an oil varnish for a month cemented together into one sticky mass, and, of course, completely ruined. When the linseed oil is thickened by the addition of a gum resin it is too thick for direct application and is thinned down with a solvent, usually turpentine or a mixture of this with light petroleum. Many resins and gum resins are used in the manufacture of varnishes in conjunction with linseed oil, but none of them can deprive the oil of the defect referred to, and, if used in too large a proportion, they become too brittle for balloon purposes. Both scientific investigation and practical experience show that any varnish containing linseed oil must be looked upon with suspicion by the aëronaut, in spite of the glowing testimonials some manufacturers are always ready to give their own goods.

When we consider those varnishes which are solutions and which do not depend upon oxidation for their drying properties we enter upon a very wide field.

Practically any substance that is soluble in a neutral solvent and leaves an impermeable film on drying is included in this class. One of the simplest examples is gelatine in its various forms with water as a solvent. Until recently glue or gelatine would have been useless for our purpose on account of its ready solubility in water, but now that we are able to render it insoluble by means of chromic acid or formaldehyde it comes within the limits of practical applicability. A fabric may be rendered almost impermeable to gas when coated on the inside with insoluble gelatine and on the outside with a waterproof varnish. Animal membranes are far less permeable to gases than fabrics coated with varnishes of the usual kinds. A balloon of gold-beater's skin, if carefully constructed, will retain hydrogen gas for a long time, and if treated with gelatine that is afterwards rendered insoluble it becomes practically impermeable. Fabrics treated

with linseed oil varnish, on the other hand, allow gas to pass with comparative ease. This is not a question of porosity or "pinholes," as is sometimes imagined, but a property inherent to the material. Hydrogen or coal gas is absorbed on the one side of the film and given off on the other in the same way as carbonic oxide will pass through heated cast iron. An inert gas, such as nitrogen, does not appear to diffuse in this way even when there is a considerable difference in pressure between the two sides of the film. Such a varnished fabric transmits hydrogen readily, but retains nitrogen and is perfectly watertight. In filling up the interstices of a fabric composed of cellulose the most obvious substance to use would be cellulose itself, but until recently solutions of this kind were difficult to obtain. Toy balloons have long been made of collodion, and are fairly satisfactory, but a cotton fabric impregnated with pure collodion becomes hard and even brittle. Celluloid solution, which is collodion with camphor and a small quantity of castor oil, is more flexible, but, probably on account of the camphor, is more permeable to hydrogen than collodion. A variety of collodion known as flexile collodion is a solution of collodion cotton with a slight addition of castor oil, and is much to be preferred to any of the preceding forms. In using it great care must be taken to exclude moisture, as the presence of this renders the film opaque, in which case it is always more or less porous. A substance allied to collodion is velvril material, composed of collodion cotton and nitrated castor oil. It is tough and flexible, even in thick films, and gives a good coating to paper or cotton fabric. Unless very carefully prepared, however, acid products may be generated from the decomposition of the nitro-compounds present, in which case the strength of the fabric would suffer. Another form of cellulose in solution is viscose, which forms a good coating when applied in a very thin layer, but makes the fabric harsh and brittle if used in excess. The solutions of this substance do not keep well and are liable to spontaneous decomposition.

The difference in flexibility between thin and thick films of the same materials is very considerable.

Given an elastic, supple cement, such as is afforded by concentrated solutions of some of the above-mentioned substances, it is quite possible to cement a tough, close-grained paper to a cotton fabric of open mesh, and the compound material thus produced is much more easily rendered impermeable than the fine cotton fabric now used. An extremely tough paper made from silk, a recent invention of T. Oishi, a Japanese manufacturer, would be specially useful for such a purpose. Its strength may be judged from the sample shown, and it will be noticed that the texture is very compact and free from pores, as might, indeed, be expected on account of the fineness of the silk fibres of which it is composed. It must not be forgotten that cotton fibres are tubes, and gas may pass through them even when they are embedded in an impermeable film. Silk fibres, on the other hand, are solid, as well as stronger than cotton.

Another way in which a tough, flexible cement may be utilised is to cement a metal foil to a textile fabric. Aluminium foil, for instance, cemented to cotton by means of flexile collodion, gives a completely impermeable fabric of much greater suppleness than the sheet aluminium hitherto used for balloons.

Fine aluminium flakes dusted upon the freshly varnished surface add greatly to the impermeability of the fabric, and the same may be said of coarsely powdered mica.

It will be evident from these notes that so far as varnishes are concerned the modern aëronaut has many resources at his disposal of which he has hitherto availed himself but little. Even if the mechanical aërostat should supersede the balloon, the aëroplanes will still necessitate an impervious and, especially, a smooth surface, and the question of a good varnish or impregnating medium will be even more important than it is at present. It is more in the direction of careful attention to details than in the discovery of any new principle that we must look for progress in aërial navigation.

The PRESIDENT: I think that this paper, though it may be considered of a technical nature, is one of the greatest importance from the point of view of the balloonist, because so far as I am aware, this subject has never been gone into from the chemical point of view by a competent authority like we know Mr. Reid is. I am very glad we have got it to publish in the Journal, and to keep as a record for all those to refer to who may want to go into the subject of ballooning materials, as well as materials for aëroplanes. I hope you will record your thanks to Mr. Reid for his paper. That will bring the proceedings to a close.

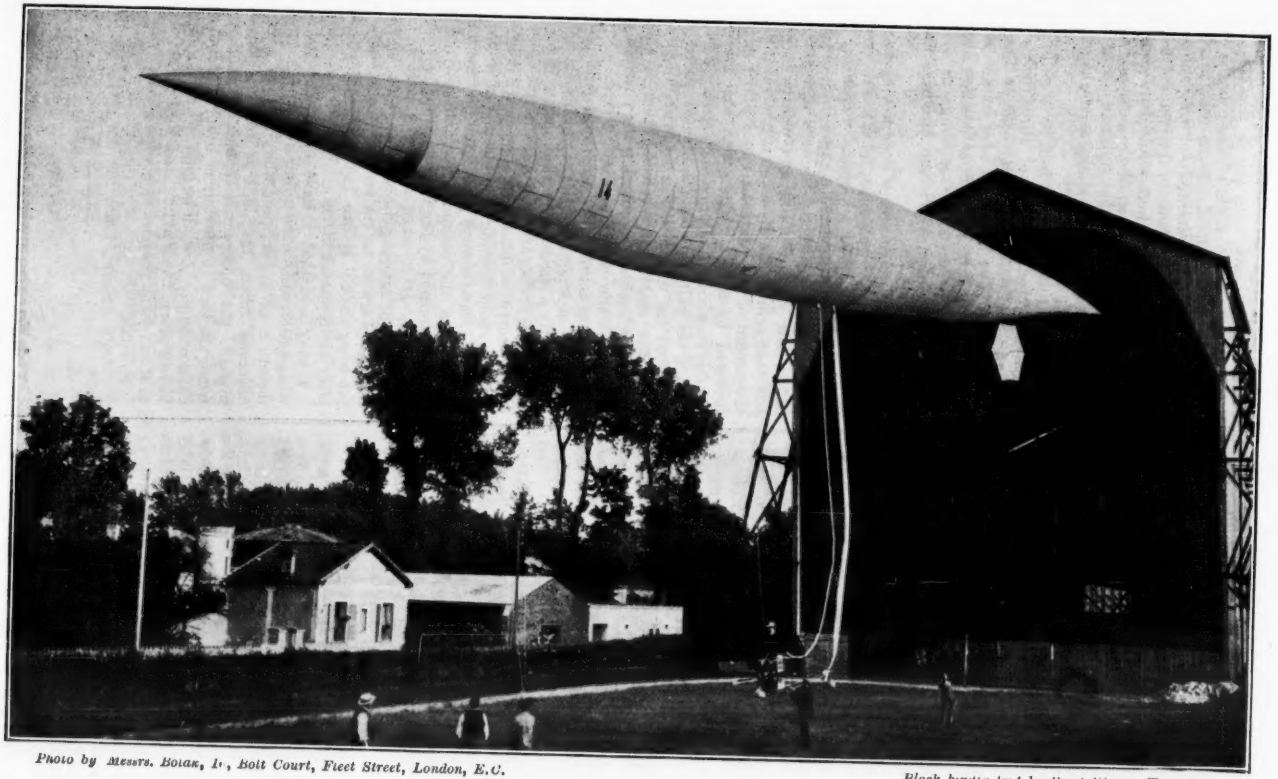


Photo by Messrs. Boiak, 1[illegible], Bolt Court, Fleet Street, London, E.C.

Block kindly lent by the Editor of THE CAR.

THE SANTOS DUMONT NO. XIV.

A vote of thanks to the President was proposed by Colonel Fullerton, seconded by Mr. E. P. Frost, and carried unanimously.

The Santos Dumont No. XIV.

In the notes of the July number of this Journal mention was made of the latest navigable balloon evolved by M. Santos Dumont, the number XIV. With pleasure we now have to record that the new airship has been successfully navigated at Tronville by the ever persevering Brazilian inventor It is stated that its stability and dirigeability have been most satisfactorily tested in an ascent over the sea. In the previous notice, to which reference has been made above, some details as to dimensions, capacity, and motive power will be found. To these it may be now added that in the present airship the propeller is situated well forward, near the motor, and the balloon is drawn along rather than propelled by it.

Obituary.

MR. F. J. STRINGFELLOW.

We regret to record the death of Mr. F. J. Stringfellow, one of the early workers on the adaptation of the aëroplane to aërial navigation. His aëroplane and steam engine were exhibited at the exhibition organised by the Aëronautical Society of Great Britain in 1868, and the prize of £100 was awarded to him for his "engine and boiler of one-horse power."*

Several pieces of aërial apparatus devised by Mr. Stringfellow, and of distinct historical interest, are in existence and in the possession of his family.

Letter to the Editor.

THE SOARING FLIGHT OF BIRDS.

To the Editor, AËRONAUTICAL JOURNAL.

SIR,—I have never seen an account of the particular wing-action described in this communication, so perhaps it may not be generally known, in which case the following particulars may be of interest to those who make a study of the soaring or gliding flight of birds.

It is a remarkable fact that the best place to study the wing-action of sea birds of the gull tribe should be in the middle of the largest town in the world; and some years ago, when the Thames Embankment was not so frequented as it is at present, I occasionally spent a quiet, almost solitary, half-hour on a winter's day watching the graceful flight of these birds. On several such occasions I noticed that previous to a bird making the alteration of wing angle, or surface, necessary for an abrupt change in the direction of its flight, there would be a preliminary elevation and return of the posterior edge of both wings when a dive followed, or of the inside wing only when a sharp turn was about to be made.

This action, which would best be described as a "flick," or "twitch," did not affect the tips of the wings, and was very rapid and of limited extent, vertically; and the edge of the wing always returned to its normal position before the further movement of the wings necessary for the dive or turn, which the bird was about to make.

This curious wing-action does not appear to be confined to the gull tribe, for a few days ago, while I was making an optical experiment, a house-marten unexpectedly came into the field of view, gliding directly towards me. It was but a few yards distant, and was clearly silhouetted against the sky when it made this rapid movement of the posterior edges of its wings, followed by a dive. The action was precisely similar to what I had previously observed in the case of the gulls, and being quite unexpected and unlooked for was rather a surprise, for, had I given the matter any consideration, I should have been inclined to question the possibility of seeing it in the case of so small a bird.

This wing-action is in no way a part of the alteration of wing angle, or surface, although it is evidently a necessary preliminary to it, for the two actions are separated by a distinct though very brief interval of time. In appearance it is very like the rapid opening and closing of a hinged valve. I have always considered its function to be to allow the escape of the air eddy, or air cushion, formed by the concave under surface of the wing. If it were merely a part of the operation of altering the wing angle, or surface, there appears to be no reason why the edge of the wing should return to its normal position after its upward motion.

I may add that I have never observed this wing-action unless preceding a sharp change of direction of flight; and that it may best be observed when the bird is moving directly towards the observer, although it can be seen when the bird is moving in other directions if close enough. I shall be glad to know if others have observed this action, and if they attribute to it the same purpose as quoted above.

ELTHAM, W. G.
16*th August*, 1905.

Notes.

The Forthcoming Milan Exhibition.—The Executive of the International Exhibition to be held at Milan, in 1906, in commemoration of the opening of the Simplon Tunnel are

* Accounts recently published have given the figures as ½ horse-power, but the above statement is quoted from the minutes of the Society, July 3rd, 1868.

making special efforts to ensure a complete representation of Aëronautical Progress. The Secretary of the Aëronautical Commission has lately visited the principalEuropean capitals so that the objects and aims of the Commission may be fully known to the various Secretaries of the now many Aëronautical Clubs and Societies. In the course of a recent interview with the Honorary Secretary of the Aëronautical Society of Great Britain, a cordial invitation was given to the members of that Society to send Aëronautical exhibits representing British progress, and to participate in the Aëronautical Competitions.

For the Aëronautical Section, specimens of every kind of Aëronautical appliances will be welcome, and in cases where exhibitors find it impossible to send the specimens themselves, photographs of instruments and diagrams descriptive of either theory or practice will be valued to adorn the wall space that is to be liberally provided. In this latter way most of those who are at work on Aërial problems could with little trouble or expense add to the Aëronautical prestige of this country.

The Executive of the Exhibition are exceedingly anxious to ensure a representative collection of the various types of scientific, or naval and military kites. In this way again members can contribute to the Exhibition with little expense; kites are extremely easy to pack and transport. Considering the daily increasing value of the kite for meteorological research, and the certainty of other nations contributing largely to the kite display, it is to be hoped that the many excellent kites that have been developed in this country will not be conspicuous by their absence.

To encourage in sending apparatus to this Exhibition the authorities have made arrangements whereby goods will be transported on the various Italian railways at a specially reduced rate.

The rules, programmes, and particulars of the Aëronautical Competitions have been printed in the languages of the various countries invited to participate. At the opening meeting of the Aëronautical Society of Great Britain, in December next, copies of the above will be found upon the table.

Aëronautical Mishaps.—Major R. F. Moore, M.Aër.Soc., has communicated the following note:—"Judging by the past, it strikes me that several of the mishaps with flying machine experiments have been due to their tendency to dive. This is to say, when the direction in flight is turned downwards, by accident or otherwise, the force of gravity acts and quickly draws the machine to earth. To avoid this, every machine should be provided with some automatic bow. In Nature, the head of the flying bird, or bat, forms the bow, and so preserves it from danger."

The Ascent of the Barton Airship.—The long-awaited ascent of the Barton Airship, which has been fully described in previous numbers of this Journal, took place from the grounds of the Alexandra Palace, on July 22nd last. It is to be regretted that the Aëroplanes, which, in their position between the deck of the airship and the gas bag, formed the distinctive feature of the enterprise, had to be removed before the ascent owing to the insufficient lifting power of the balloon. The value of the combination of Aëroplanes and balloon in facilitating the vertical movements of the airship therefore remains untested.

The safe exit of the monster balloon from its shed, and its successful ascent into the air, began to instil great expectations on the part of the assembled crowds; but it was soon evident that the motive power at the command of the Aëronauts would not be equal to the task of overcoming the wind force that prevailed. The airship, in fact, succumbed to its influence, and, in the manner of an ordinary balloon, drifted with the breeze. The descent was made at Romford, in Essex, and it is stated that the balloon came down on a perfectly even keel. Shortly after that came the most dangerous situation of the voyage. Some members of the crew thought that sufficient gas had been let out to allow of their congregating at one end of the vessel, the consequence being that she rose at the stern end. To avoid disaster it was therefore necessary to rip open the balloon to bring it down again. Though there appears little further to record in connection with the ascent, still there is one good point connected with the experiment which ought to be commended, that was the calling in of expert professional assistance in the manœuvering of the balloon. In some experiments in the past inventors and engineers have relied too much on their own untrained and limited experience of the ways of the air, and with fearful consequences. Too much praise cannot be bestowed on M. Gaudron for his presence of mind, at a critical moment of the ascent, and thus averting chance of a catastrophe at the termination of the airship spectacle of the Alexandra Palace.

Mr. Frank Butler's Ascent to view the Eclipse of the Sun.—Owing to obscuring clouds few Londoners saw anything of the recent Eclipse of the Sun, and the only knowledge of the event was the lowering of temperature during the time of partial eclipse causing many to have recourse to their ulsters without remembering the cause of the sudden chilliness of the atmosphere.

It is not surprising that so skilful an Aëronaut as Mr. Frank Butler should take advantage of his ballooning facilities, and laughing the proverbial British clouds to scorn left them far behind, and not only watched the eclipse in serenity of atmosphere, but took some capital photographs of the partially obscured disc.

Mr. Percival Spencer, who accompanied Mr. Butler, thus described the observation of the eclipse to "The Standard," in which paper a

very full account of the ascent appeared:—"At half-past twelve the ascent commenced, and at 12.40, through the upper clouds, we saw the sun a crescent. We were then 2,000 feet high, and still rising. Soon more clouds intervened, and in another five minutes we had reached 3,000 feet, and the Sun was quite obscured by the upper clouds. The balloon was now reaching its equilibrium, and at ten minutes to one a hundred weight of sand was discharged which had the effect of so lightening it that a continual and regular rise ensued. At five minutes to one we were 4,500 feet high, saw the eclipse well, and took our first photographs of it. From one o'clock to twenty minutes past we had a continual and uninterrupted view and proceeded to take photographs at regular intervals until, at 1.30, we had reached 6,000 feet high; and now so much cloud had been left underneath, that we found the light so strong that the view could not be obtained with our obscured glasses. The Sun's rays were too powerful. We overcame this by using two glasses, and thus we not only continued to view the increasing rays, but continued to take photographs with our fumed glasses in front of the lens.

The ascent terminated at 2.4, and the balloon descending passed over Shoreham to the sea. But the trip was destined to combine sport with usefulness, and to the ascent to observe the sun was added a cross-Channel pleasure excursion. This Mr. Frank Butler thus describes in "The World":—"We had calculated to reach France in three and a half hours at the rate of speed we had been travelling from London to Brighton, which was thirty-three and a half miles an hour. Descending again we saw nothing but a rough sea, but our compass showed that we were still going south. We tied up our cameras in the hoop to prevent the films getting wet, in case we came down into the sea. At last we saw a seagull, and soon after some fishing boats, so we thought we were near the French coast. At 7.45 p.m. a lighthouse and the lights of a town appeared which we thought was Trouville. We soon arrived over the town and heard the shouts of people in the casino. We landed in some fields at La Délivrande, near Caen, in Normandy, after being dragged a mile across the fields before the grapnel would hold." The Aëronauts claim to have had a voyage of one hundred miles, crossing the widest part of the Channel.

The Knabenshue Airship.—The airship devised by Mr. Knabenshue, the American inventor, which has been successfully navigated in New York, is very similar in design to the Santos Dumont type. In one detail, however, he departs from the design of the latter. He dispenses with the rigid steel wires, which in the Santos Dumont construction attach the framework to the balloon, and depends upon the old-fashioned net. The outfit that has to be lifted by the balloon is very light, weighing less than 350 lbs.; but, in consequence, his motor develops only ten-horse power. The basket in the framework is abolished, and the inventor is content with the support of the triangular frame. By shifting the weight of his body the nose of the machine is directed upwards or downwards.

Recent Aëronautical Tragedies.—The two tragedies of the air that have occurred since this Journal was last published can only be said to be the result of uncommendable risk to life and limb. A writer in this Journal, in July last, pointed out that the experiment with Professor Montgomery's aëroplane, in America, was but a dangerous form of parachuting. Too soon did his words prove true, for shortly after their publication the luckless aëronaut, who was demonstrating the supposed stability of the aëroplane, met his death.

In the case of the accident at Greenville, Ohio, when Mr. Baldwin was blown to pieces by the explosion of dynamite, a disaster could only be expected when dynamite was discharged from a balloon in so rough-and-ready a fashion, without infinite and well-thought-out precautions. Such accidents are to be deplored, inasmuch as they tend to detract from the public interest in careful and legitimate experiments in aërial navigation.

Foreign Aëronautical Publications.

(In this list a selection of some of the more notable articles is only given.)

L'AÉRONAUTE (Paris).

July, 1905.—Observations sur les théories et les expériences d'aviation de M. Roux (Paul Delaporte).—Le Lebaudy au Camp de Chalons (M. de Fonvielle).—Transport d'amarres au moyen d'un cerf-volant dispositif à double déclenchement (M. Vareilles).

August.—Apropos de l'eclipse du 30 Août (Mme. Isaac Roberts).

L'AÉROPHILE (Paris).

July, 1905.—Portraits d'Aéronautes Contemporains: Charles Levée (Georges Bans).—Les expériences du "Lebaudy" (A. de Masfrand).

August, 1905.—Portraits d'Aéronautes Contemporains: Le Lieutenant-Colonel Hirschauer. (Georges Besançon).—Le premier Aéronaut Italien (Georges Blanchet).—L'Hélicoptère (M. Léger).—Les essais et la castrophe du Santa-Clara (A. de Masfrand).

ILLUSTRIRTE AËRONAUTISCHE MITTEILUNGEN (Strassburg).

July, 1905.—Die Russische Militärluftschiffahrt (W. L. Moëdebeck).

August.—Des Herrn Jean Paul Gärtner Beschreibung Seiner um 13 Aprill, 1803, mit Herrn Garnerin und dessen Gattin unternommenen Luftreise Zu Berlin.--Beiträge zur Theorie der Drachen in ihser anwendung für Meteorologische Hochaufstiege (R. Nimführ).

September.—Uber Winddruck und Winddruckmesser.—Lehrreiche Aëronautische Photographien.

VIENER LUFTSCHIFFER-ZEITUNG.

July, 1905.—Zur Flugfrage.—Im interesse der Flugtechnik (Joseph Wartscher).—Die Juni-Hochfahrt.—Experimentelstudien (Roman König).

August.—Sensationsfahrt des Wiener Aëro-Klubs.—Die Hochfahrt auf. 7,800 meter.—Internationale Ballonfahrt vom 5 Juli, 1905.—Meine Junfern-Luftsfahrt. — Der Unfall Des Lebaudy.—Experimentelstudien.

Applications for Patents.

(*Made in July, August, and September, 1905.*)

The following list of Applications for Patents connected with Aëronautics has been specially compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.

JULY.

14309. July 11th. LAWRENCE HUGH CARROLL, SOLOMON JACOBS, AND WILLIAM MCINTOSH. **An improved Flying Machine.**

15376. July 26th. HORATIO FREDERICK PHILLIPS. **Improvements in Flying Machines.**

15613. July 31st. HENRY SHEPLEY BOOTH. **Improvements in Aërial machines.**

AUGUST.

15698. August 1st. EDWIN RICHARD MUMFORD. **Improvements in or connected with Aërodromes or Flying Machines.**

15858. August 2nd. DAVID THOMAS. **An Anchor for Air-ships.**

16308. August 10th. ALFRED GEORGE MELHUISH. **Improved method of and means for Propelling Air-ships, Motor-cars, Bicycles, Tricycles, and other Machines, applicable also for other purposes.**

16492. August 14th. ALBERT G. FLOWER. **Safety Belts for persons and children using Balloons, Perambulators, or other Vehicles, or Chairs.**

16838. August 19th. FRANZ WONDRA. **Improvements in or relating to Flying Machines.**

SEPTEMBER.

17935. Sept. 5th. FREDERICK WILLIAM LANCHESTER. **Improvements in Aërodromes.**